U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

LANDING CONTROL CENTRALS

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide methods of evaluating the technical performance, engineering adequacy, and technical characteristics of landing control centrals relative to criteria specified in Quality Materiel Requirements (QMR), Small Development Requirements (SDR), or other applicable documents, and determining their suitability for an intended use.

2. BACKGROUND

The landing control central is designed to provide a rugged compact, air transportable air traffic control facility for army airfields and landing areas. The landing control central contains equipment to provide the necessary data acquisition and communication capability to enable the air traffic controller to guide and direct aircraft pilots to a safe takeoff or landing.

The major components of the system may include a surveillance and ground control approach (GCA) radar set, interrogation friend or foe (IFF) equipment, meteorological equipment, air-to-ground and ground to ground communication equipment which are contained in a truck shelter and trailer.

3. REQUIRED EQUIPMENT

a. Support aircraft with compatible radio sets and transponders.
b. Airfield test facility.
c. Meteorological support facility.
d. Test equipment as required.
e. Photographic equipment (color, black and white film)

4. REFERENCES

A. Letter Report, Engineering Test for Landing Control Central AN/TSQ-72, U. S. Army Electronic Proving Ground, Fort Huachuca, Arizona, 24 April 1968

B. Category II System Development Test and Evaluation of the 482L Emergency Mission Support System, APGC-TR-65-61, Volumes I, II, and III, Air Proving Ground Center, Elgin Air Force Base, Florida, December 1965

C. Haverkos, N. P., Evaluation of the AN/TSW-5, Air Traffic Control Central of the AN/TSQ-47 System, ESD-TR-64-449, prepared by AVCO Corporation, Cincinnati, Ohio for Air Force Systems Command, Hanscom Field, Bedford, Massachusetts, December 1964, (AD 458-666)

D. TM-11-5840-281-15, Operator, Organizational, Field and Depot Maintenance Manual Radar Set AN/TPN-8, and AN/TPN-18, September 1967.

E. POMM 11-5895-455-14, Instruction Manual for Flight Operations Central (V-79).
F. POMM 11-5895-474-15, Preliminary Operating and Maintenance Manuals for Landing Control Central AN/TSQ-71 and AN/TSQ-72.
G. QMR for Army Manual Air Traffic Control, 8 October 1964.
H. SCL-1280D, Design of Electronic Equipment for System Installation in Shelters and Vans, 15 March 1965.
I. MIL-STD-449, Radio Frequency Spectrum Characteristics, Measurement of.
J. MIL-STD-461, Electromagnetic Interference Characteristics, Requirements for Equipment.
K. MIL-STD-810-B, Environmental Test Methods.
L. MTP 3-1-002, Confidence Intervals and Sample Size.
M. MTP 6-2-020, Radar Antenna Subsystem Tests.
N. MTP 6-2-030, Beacon Devices, Electronic.
O. MTP 6-2-189, Wind Measuring Equipment, Surface.
P. MTP 6-2-222, Radar, Target and Ranging.
Q. MTP 6-2-242, Receiver-Transmitter, General.

5. SCOPE

5.1 SUMMARY

5.1.1 Technical Characteristics

The procedures outlined in this MTP provide general guidance for determining and evaluating the technical performance and technical characteristics landing control central. The cumulative test results together with the results of the appropriate Common Engineering Tests will allow an estimate of the test item's capabilities and the suitability of the equipment to meet the operational need.

The specific tests to be performed, along with their intended objectives are listed below:

a. Component Tests - The objective of this subtest is to determine the technical performance characteristics of the individual components of the landing control central which include the surveillance and GCA Radar Set, interrogator set, wind measuring set and radio set.

b. Systems Tests - The objective of this subtest is to determine:

1) Combined Antenna Pattern Test - The distortion or mutual coupling effects of the multiple collocated antennas on the basic field pattern of each antenna.
2) Communication Range Test - The operational range of each radio set (HF, VHF, UHF, and FM) at the various azimuth headings.
3) Space Position and IFF Data Acquisition Test - The operational surveillance radar range and IFF data acquisition capability at the various azimuth headings.

5.1.2 Common Engineering Tests

Not included in this MTP are the following Common Engineering Tests which apply to these commodities:

A. 6-2-500, Physical Characteristics
B. 6-2-502, Human Factors
C. 6-2-504, Design for Maintainability
D. 6-2-507, Safety
E. 6-2-509, Electromagnetic Compatibility
F. 6-2-514, Electrical Power Requirements
G. 6-2-516, Adequacy of Lighting, Ventilation, Air Conditioning and Heating Equipment.
H. 6-2-520, Transportability of Communications, Surveillance and Electronic Equipment.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Select test equipment ideally having an accuracy of ten orders of magnitude greater than that of the item under test, and that is in keeping with the state of the art and with calibrations traceable to the National Bureau of Standards.

b. Record the following information:

1) Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.
2) Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the test items under test, such as stipulated in QMR's, SDR's, and TC's.

d. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test.

e. Prepare record forms for systematic entry of data, chronology of tests, and analysis in final evaluation of the test item.

f. Prepare a test item sample plan sufficient to ensure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with MTP 3-1-002. Provisions shall be made for modification during test progress as indicated by monitored test results.

g. Ensure that all test personnel have reviewed all instructional material issued with the test item by the manufacturer, contractor, or government, and performed such preliminary tests as necessary to assure that the test item is in satisfactory condition.

NOTE: Whatever, the actual calibration or test procedure to be followed, preliminary preparation of the test item should always include:

1) Visual inspection for obvious physical defects.
2) Preliminary maintenance pointed out by the previous steps.
3) Zero setting of all indicators.
4) Determination of "intended use" position of the various instruments.
5) Sufficient warm-up time for all electronic devices.

h. Coordinate with the Meteorological Support Facility to ensure that meteorological information (temperature, humidity and pressure) is obtained during all periods of operation.

NOTE: Frequency at which the meteorological observations are to be repeated shall be as mutually agreed upon by the test engineer and the support facility.

6.2 TEST CONDUCT

6.2.1 Component Tests

Subject the individual components of the item under test to the procedures of MTP's 6-2-020, 6-2-125, 6-2-189, 6-2-222, and 6-2-242.

6.2.2 SYSTEM TESTS

6.2.2.1 Combined Antenna Pattern Test

Conduct the combined antenna pattern test in accordance with the applicable portions of MTP 6-2-020, Radar Antennas Subsystems and include the following:

a. Determine the mutual coupling effects of the multiple collocated antennas on each individual antenna pattern by adding one antenna at a time to the test item, obtain the resulting pattern and continue until the effects of the total group are determined.

b. Record the following data for each configuration:

1) Freqency (Hz)
2) Relative power (db)
3) Azimuth (degrees)
4) Location of antennas
5) Effects of the total group

6.2.2.2 Communication Range Test

The communication range for each radio set installed in the test item shall be determined by operational test involving communication with supporting aircraft personnel as follows:

a. The aircraft shall proceed outbound from the test item at the approved low altitude to the maximum range (not to exceed 150 nautical miles)

of the HF, VHF, UHF, and FM radio sets.

b. Communications shall be established with the aircraft at each 5-mile interval until contact is lost. Record the range altitude, and azimuth of the aircraft at each check position.

c. Upon loss of radio contact the aircraft shall reverse course and proceed inbound until communication is re-established with each radio set. Record the range, altitude, and azimuth upon re-establishment of radio contact.

d. The procedures of steps b and c above shall be repeated for various headings.

6.2.2.3 Space Position and IFF Data Acquisition

a. The space position and IFF Data acquisition capability of the test item shall be determined by an operational test utilizing a test range space positioning capability such as radar surveillance of the aircraft and the exercise of IFF equipment.

b. Track the support aircraft with the tracking radar and through communications with the test personnel, radar site operator and aircraft personnel confirm the accuracy of the radar.

c. The tracking radar operator and test personnel shall vector the aircraft outbound from the test site.

d. The test radar operator shall instruct the track radar operator to mark the plot when the radar indicates an aircraft position intercept with each range marker.

e. The outbound flight will be continued to the maximum range and the radar operator shall record the range at which the target signal is lost.

f. At least one IFF challenge shall be made at each 5-mile interval to determine IFF signal response on the radar receiver.

g. On the inbound flight, the range at which the target signal appears on the radar scope shall be recorded. IFF challenges shall be made as in the outbound flight.

h. Procedures of paragraphs c through f shall be repeated for various headings.

6.3 TEST DATA

6.3.1 Preparation for Test Data

Data to be recorded prior to testing shall include:

a. Test item nomenclature and serial number
b. Test equipment nomenclature and serial number
c. Test equipment calibration date and traceability
d. Test equipment accuracy and stability figures

6.3.2 General

Data to be recorded in addition to specific instructions listed for each individual subtest shall include the following:

a. An engineering log book containing in chronological order, per-

tinent remarks, block diagrams of test setups, and observations which will augment test data and support engineering evaluation and analysis of the technical performance of the test item.

b. Supporting photographs, calibration records, and recordings of test anomalies or deviations from the test plan made where necessary.

6.3.3 Component Test

Component test data to be recorded shall be those relevant to design requirements and required by selected procedures of referenced MTP's in paragraph 6.2.1.1.

6.3.4 System Tests

6.3.4.1 Combined Antenna Pattern Test

The test data to be recorded for each antenna configuration shall be as indicated below:

a. Frequency (Hz)
b. Relative power (db)
c. Azimuth (degrees)
d. Location of antennas

6.3.4.2 Communication Range Test

Communication range test data for each radio to be recorded shall be indicated below:

a. Frequency (Hz)
b. Range (nautical mile)
c. Azimuth (degrees)
d. Altitude of aircraft (feet)

6.3.4.3 Space Position and IFF Data Acquisition

Space position and IFF data to be recorded shall be as indicated below:

a. Range (nautical miles - from test radar)
b. Range (nautical miles - from tracking radar)
c. Azimuth (degrees)
d. Altitude of aircraft (feet)
e. Characteristics of observed IFF signal

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data, in general, includes but is not limited to the following steps:

a. Marking test data for identification and correlation

b. Organizing data into tabular and graphical form
c. Modifying data to correct for nonstandard conditions

It is noted that the test directive (or operation) itself serves to define the types and characteristics of the raw test data, and the ultimate objective of the test program defines the form of the test data desired.

Specific instruction for the reduction and presentation of individual subtest data are outlined in subsequent paragraphs.

6.4.1 Component Tests

Component performance data shall be reduced and presented in accordance with the design requirements for those equipments and with the selected procedures of MTP's listed in paragraph 6.2.2.

6.4.2 System Tests

6.4.2.1 Combined Antenna Pattern Test

Combined antenna pattern test data shall be reduced to polar plots of the field pattern (db versus degrees) and shall be presented together with the following supporting data:

a. Frequency (Hz)
b. Location of antennas

6.4.4.2 Communication Range

Communication range test data shall be presented in the form of tabular listings of the following parameters.

a. Frequency (Hz)
b. Range (nautical mile)
c. Azimuth (degrees)
d. Altitude of aircraft (feet)

6.4.4.3 Space Position and IFF Data Acquisition

Space position and IFF data acquisition test data shall be presented in the form of tabular listings of the following parameters:

a. Range (nautical miles - from test radar)
b. Range (nautical miles - from tracking radar)
c. Azimuth (degrees)
d. Altitude of aircraft (feet)
e. Characteristics of observed IFF signal